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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Boiler Tube Cleaning Apparatus

We, POWER TUBE, INC., of 2320 N. W. Westover Road, Portland, Oregon, United States of America; a corporation organised and existing under the laws of the State of Oregon, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for cleaning the tubes of a boiler.

A common form of boiler includes multiple fire tubes disposed side by side and parallel to each other in the boiler, which periodically must be cleaned of soot and scale in order to maintain the efficiency of the boiler. Studies have shown that the presence of only a small accumulation of scale, ash or soot on the walls of boiler tubes will result in a considerable loss of efficiency. This invention more specifically concerns cleaning apparatus which features a shaft having a boiler tube cleaning instrument mounted on one end thereof, and an ejector which may be operated to thrust the shaft inside a tube so that the cleaning instrument thereon moves along the inside of the tube with such instrument then scraping and brushing the tube.

A general object of this invention is to provide cleaning apparatus of this description which includes a power-operated ejector unit for thrusting a shaft forwardly into a boiler tube, and novel means mounting such unit whereby the same is supported in such a manner as to be fully braced against the reaction forces set up in the unit when the unit is operated. It is also an object that the mounting for the unit should at the same time enable the unit to be readily moved to place it in proper position for successively cleaning a plurality of tubes.

Accordingly the present invention consists in an apparatus for cleaning boiler tubes, having an ejector unit for thrusting a boiler tube cleaning instrument into and along the length

of a boiler tube, upper and lower tracks being mounted adjacent the top and bottom of a boiler and substantially parallel to each other and to tube rows, a standard spanning the space between the tracks, means moveable along the upper track anchoring the upper end of the standard thereto and means moveable along the lower track anchoring the lower end of the standard thereto, the ejector unit being mounted on the standard moveably therealong and means being provided for holding the said unit in an adjusted position.

Preferably each track comprises a rail having an upper guide edge and a rear side facing the ends of the boiler tubes in the boiler, the moveable means anchoring an end of the standard to a track including means engaging the rear side and guide edge of the rail.

Advantageously the means anchoring the lower end of the standard includes an adjustable mechanism allowing release of the standard from the rail whereby the released end may be swung laterally and forwardly of the rail.

Advantageously the means anchoring the upper end of the standard allows swinging of the standard about an axis substantially parallel to the tracks.

In order that the invention may be more readily understood reference will now be made to the accompanying drawings, wherein

Fig. 1 is a side elevation of apparatus constructed according to this invention, showing portions of a boiler and with cleaning apparatus mounted in front thereof;

Fig. 2 is an end elevation of the apparatus illustrated in Fig. 1;

Fig. 3 is a cross sectional view, taken generally along the lines 3—3 in Fig. 2, and on an enlarged scale, illustrating details of an ejector unit employed to thrust a shaft into a tube for cleaning purposes; and

Fig. 4 is an enlarged view of portions of a shaft used in the apparatus for mounting a tube cleaning instrument.

Referring now to the drawings, in Figs. 1

and 2 a boiler 10 is indicated, which has mounted therewithin a bank of fire tubes, indicated individually at 12. A shell 14 surrounds these tubes, and as is common with boilers, doors 16 may be provided that normally close off the end of the boiler and that are swung apart on hinges 18 to open up the end of the boiler for cleaning purposes. Tubes 12 within the boiler are shown extending through a plate 20 mounting the tubes in place. The tubes at opposite ends of the boiler have open ends.

In a given installation, it is not uncommon to find a number of the boilers of the type described mounted side by side. With the apparatus of the invention a plurality of such boilers may be serviced by cleaning the fire tubes of each.

As contemplated herein, a stationary framework is provided, which is mounted adjacent the ends of a series of boilers of the type described. This framework supports a power-driven ejector unit which is actuated to produce cleaning of a tube. The framework accommodates movement of the ejector unit in a direction extending transversely of the boilers, whereby successive vertical rows of tubes may be cleaned using the same ejector unit. In Figs. 1 and 2, this framework is indicated generally at 26.

Considering details of framework 26, at 30 there is illustrated an upper track, comprising a rail which extends transversely of boiler 10 and which is mounted slightly in front of one end of the boiler. Secured, as by welding, to the shell of boiler 10 is bracket structure 34, which is effective to hold rail 30 securely in a fixed position. While rail 30 has been shown broken off, in a multiple boiler installation, the rail extends as shown across the ends of all boilers.

Paralleling rail 30, and shown extending transversely of the boiler adjacent the bottom of the boiler is another track 36. This track also may comprise a rail, which is mounted in a fixed position, by means of brackets 40 secured to the boiler adjacent the base of the boiler.

According to this invention, a power-driven ejector unit, shown generally at 42, is actuated to thrust forwardly a shaft 43 having a cleaning instrument mounted on one end, shown generally at 44, with the cleaning instrument then moving down the interior of a fire tube. This produces reaction forces in the ejector unit, whereby the same tends to be thrown backwardly away from the boiler and the tube being cleaned. The upper and lower tracks described provide a mounting for this ejector unit accommodating movement of the ejector unit in a transverse direction, while ruggedly bracing the unit so as to prevent the same from being thrown backwardly when the same is operated.

Further describing the mounting for the ejector unit, an upright standard or rail is shown at 46. Mounting the upper end of standard 46 on rail 30 is a trolley or traveling anchoring means 48, including a body 50 with flanged wheels 52 journaled thereon. A sleeve or socket 56 having standard 46 extending upwardly therethrough is joined to body 50. A hand-wheel adjusted screw 58 mounted on this sleeve may be tightened to clamp the standard in a given position within the sleeve. In the construction described, the top edge of rail 30 supports the weight of the apparatus, and flanges 52a of wheels 52, by engaging the back side of rail 30, i.e., the side facing the boilers, function to prevent the trolley from being forced to the right in Fig. 1, or forwardly of the boiler and off the track.

The bottom end of standard 46 is mounted on the lower track through traveling anchoring means or guide 60. This guide includes a plate 62 that is slidable along the back side of rail 36, and in front of this plate a channel-shaped part 64 which fits about standard 46. Pivotcd to channel-shaped part 64 is a gate 66 (pivoted at 68), which is detachably joined to part 64 in back of it by a hand-wheel adjusted screw 70. Thus, by loosening the handwheel screw and swinging the gate outwardly, the base of standard 46 is released. The base of the standard when it is released, may be swung outwardly from the boiler and rail 36, with the standard pivoting above an axis generally corresponding to the top of rail 30 (trolley 48 being tiltable to some extent on the top of rail 30). This is an important feature, since in boiler installations, furnaces and other equipment are often found in front of the boilers, and these would offer an impassable obstruction to a standard whose base was constrained to movement along rail 36. By providing the gate and because the standard is swingable as described, the standard is easily shifted past such an obstruction.

Power-driven ejector unit 42 is mounted on a carriage 72 mounted for up and down movement on the standard. At 74 is a hand-wheel adjusted screw, which may be tightened to secure the carriage in place, in different positions on the standard. Also mounted on the carriage is an electric motor 76. Motor 76 and unit 42 are on opposite sides of a plate 78 which is part of the carriage.

Referring now to Fig. 3, unit 42 comprises a housing 80 having journaled therewithin oppositely disposed grooved wheels 82, 84, also referred to as clamping wheels. Wheel 82 constitutes a power-driven wheel, and is connected directly to the output shaft of motor 76. Wheel 84 is a pressure-applying wheel, and is journaled on a member 86 which is pivoted at 88 within the housing. A hand-wheel adjusted nut 90 is screwed onto a stud 92, and the latter is anchored at 94 within the housing. Encircling stud 92 is a spring 96, interposed between member 86 and hand-wheel adjusted nut 90. Spring 96 exerts a bias

- on member 86, and it will be obvious that by tightening the hand-wheel adjusted nut, a greater compressive force is exerted by the spring on member 86, whereby wheel 84 is urged with greater force toward wheel 82. Shaft 43 which has cleaning instrument 44 mounted thereon, and referring to Fig. 4, comprises a spring steel, helically wound, hollow body 102. Within body 102 is a cable 104. The cable extends along the inside of the spring steel hollow body, and is secured to the body at the ends of the body by an anchor connection such as the one shown at 106 in Fig. 4. With this construction the shaft is flexible, since the windings of the hollow body may flex with respect to each other and at the same time, the shaft constitutes a thrust transmitting member, in that when the same is thrust forwardly it will transfer this thrust to the cleaning instrument mounted at its forward end. Further, the shaft is a tension-transmitting member, and on being withdrawn will not stretch out because of the inclusion of cable 104 within it which is nonextensible.
- Shaft 43 is moved forwardly into a tube and withdrawn from the tube by the power-driven ejector unit, more specifically by the action of wheels 82, 84 within the unit which engage the shaft on opposite sides. As can be seen in Fig. 3, the shaft enters housing 80 through a funnel-shaped portion 108 of the casing. After passing between wheels 82, 84, the shaft extends through a nozzle part or shaft guide 110, which is pivoted within the housing at 112. The nozzle part is included in order to afford control over the direction in which the shaft is fed out from the ejector unit. It will be noted that an ear 114 is provided which projects upwardly from the nozzle part, and that a stud 116 anchored to the housing at 118 extends through a slot in ear 114. A compression spring 120 encircles the stud, and a hand-wheel adjusted nut is shown at 122 which is screwed onto stud 116. On tightening the hand-wheel adjusted nut, the nozzle part swings upwardly, and on loosening the nut, the nozzle part swings downwardly, spring 120 functioning to keep ear 114 tight against nut 122. With the nozzle part swung upwardly, the shaft where it extends out from the nozzle part is directed upwardly, and on swinging the part downwardly, the shaft is directed downwardly.
- As can be seen in Fig. 1, cleaning instrument 44 includes a scraper 124, and a brush 126. These are mounted on an end of the shaft through a fitting 128. The opposite end of the shaft may be connected, as by chain 130, to an ear 132 which extends out from the casing of ejector unit 42.
- Completing the description of the invention, to raise and lower carriage 72 and the ejector unit, a winch 134 and a cable 136 is provided. The lower end of the cable is wrapped around the drum of the winch, and from thence the cable passes upwardly over a pulley 138 and downwardly to a connection 140 with plate 78 of the carriage. From this it should be obvious that on proper actuation of the winch, the carriage may be shifted either upwardly or downwardly on the standard.
- Explaining how the apparatus may be used to clean the tubes in a boiler, the carriage may first be placed at an elevation, such that the forward end of the shaft projecting from ejector unit 42 and instrument 44 are at substantially the same level as a bank of tubes within the boiler. Electric motor 76, which is reversible, is then operated, first to advance the shaft into a tube, with the tube then being cleaned. An operator, as by noting the extent to which the shaft has traveled into a tube, determines when instrument 44 has traveled the length of the tube. The operator may then reverse motor 76, whereby the shaft and instrument 44 are withdrawn. An operator may then easily shift the standard, using the trolley supporting it at the top, and the guide at the bottom, to place the shaft in front of a tube next to the tube just cleaned. The cleaning operation may then be repeated. On cleaning the tubes in a given level, the winch may be operated to either lower or raise the carriage, depending upon which level of tubes is to be cleaned next. The operation may then be repeated.
- Where it is desired to make small adjustments in the direction in which the shaft is thrust forwardly from the ejector unit, such can be done by proper manipulation of hand-wheel nut 122. This feature is especially important when cleaning a level of tubes that otherwise would be too high or too low to be reachable with unit 42 with a nozzle part pointing straight ahead.
- An important part of the invention is that during movement of the shaft into and along a dirty tube, the ejector unit is ruggedly braced to resist reaction forces set up therein. This is because both top and bottom positions of the standard are held securely from displacement laterally of the tracks. The structure is relatively compact, and as already noted, the standard may be released adjacent its bottom from the lower guide, to accommodate its being swung out and around obstructions such as furnaces and the like.
- Because the shaft is flexible, a great deal of space to provide clearance for the shaft when the same is retracted is not needed.
- WHAT WE CLAIM IS:—**
1. An apparatus for cleaning boiler tubes, having an ejector unit for thrusting a boiler tube cleaning instrument into and along the length of a boiler tube, upper and lower tracks being mounted adjacent the top and bottom of a boiler and substantially parallel to each other and to tube rows, a standard spanning

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- the space between the tracks, means moveable along the upper track anchoring the upper end of the standard thereto and means moveable along the lower track anchoring the lower end of the standard thereto, the ejector unit being mounted on the standard moveably therealong and means being provided for holding the said unit in an adjusted position. 30
5. An apparatus as claimed in claim 1, wherein each track comprises a rail having an upper guide edge and a rear side facing the ends of the boiler tubes in the boiler, the moveably means anchoring an end of the standard to a track including means engaging the rear side and guide edge of the rail. 35
10. An apparatus as claimed in claim 1, wherein the means anchoring the lower end of the standard includes an adjustable mechanism allowing release of the standard from the rail whereby the released end may be swung laterally and forwardly of the rail. 40
15. An apparatus as claimed in claim 2, wherein the means anchoring the lower end of the standard allows swinging of the standard about an axis substantially parallel to the tracks. 45
20. An apparatus as claimed in any previous claim wherein the means anchoring the upper end of the standard allows swinging of the standard about an axis substantially parallel to the tracks. 50
25. An apparatus as claimed in any preceding claim wherein the ejector unit includes a shaft guide which is located to one side of the standard and means for advancing a shaft through said guide. 55
6. An apparatus as claimed in claim 5, wherein power-operated means are provided for advancing the shaft through the guide. 35
7. An apparatus as claimed in claim 6, wherein the power-operated means comprises a pair of oppositely disposed clamping wheels, a motor connected to one wheel for rotating it under power, and means connected to the other wheel exerting a bias on the wheel whereby the two wheels are urged together to clamp onto the shaft. 40
8. An apparatus as claimed in claim 5, 6 or 7, wherein the shaft guide comprises an elongated nozzle, and the nozzle has an end which is movable to change the direction along which the shaft travels on passing through the nozzle. 45
9. An apparatus as claimed in any of claims 5 to 8, wherein the shaft is flexible and comprises an outer helical winding and a cable inside, the winding anchored to the ends of the shaft to inhibit elongation of the shaft and the winds of the helical winding inhibiting compression of the shaft. 50
10. An apparatus for cleaning boiler tubes, substantially as described and claimed with reference to the accompanying drawings. 55

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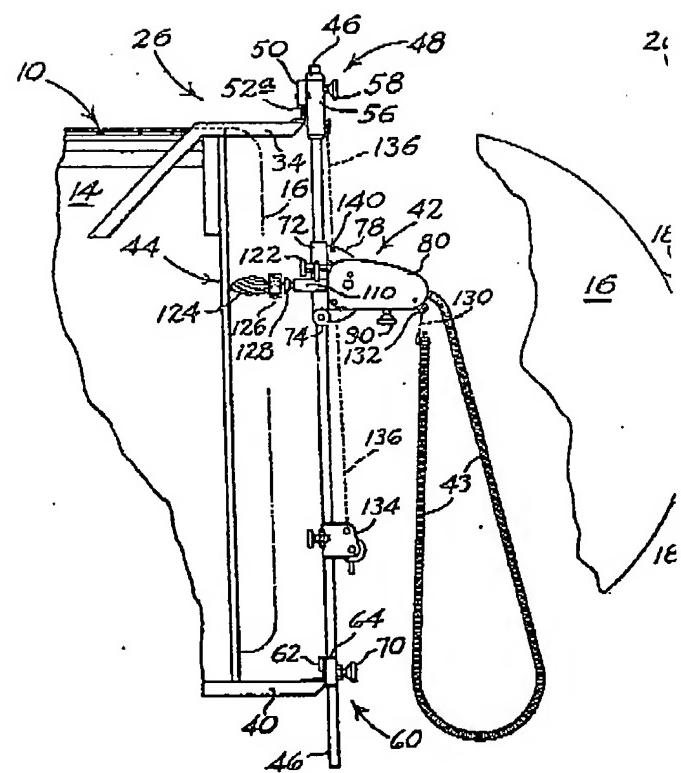


Fig. 1.

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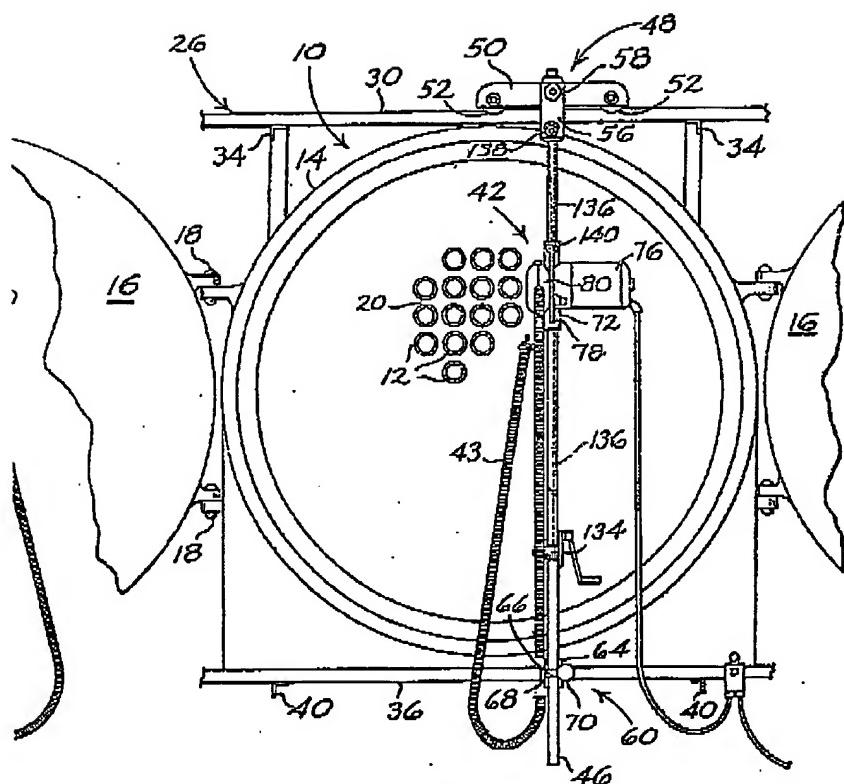
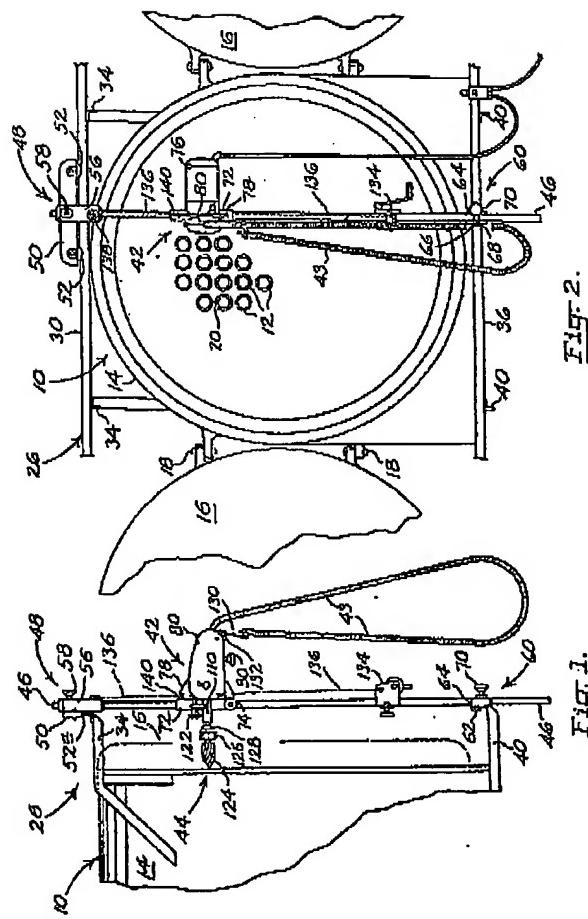


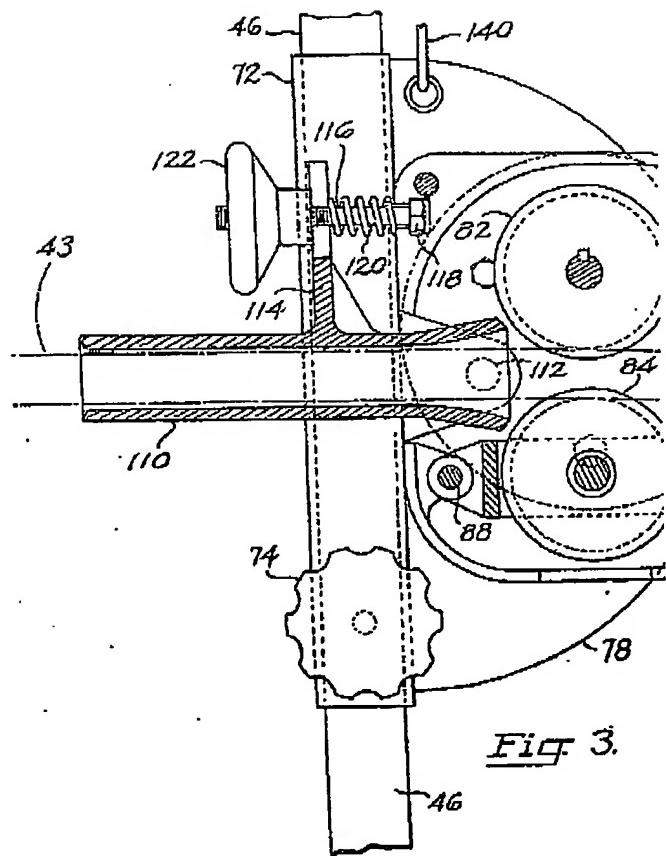
Fig. 2.

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Fig. 1.



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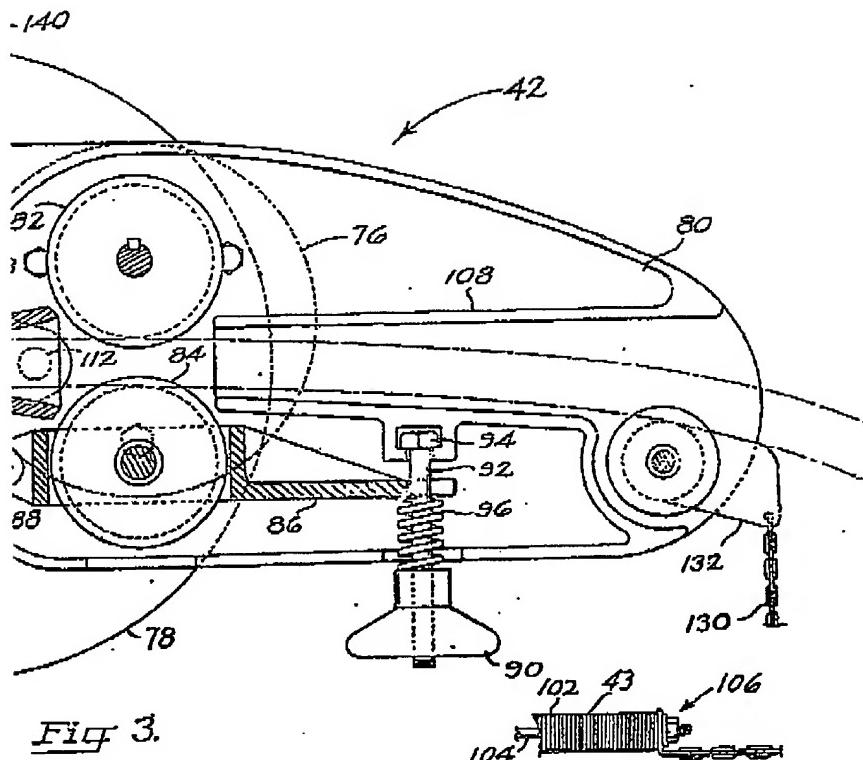


Fig. 3.



Fig. 4.

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